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Koga et al.

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(54) **SHEET FEEDING UNIT, SHEET FEEDING APPARATUS, AND IMAGE FORMING APPARATUS**

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(30) **Foreign Application Priority Data**

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Oct. 19, 2005 (JP) 2005-304258

(51) **Int. Cl.**
B65H 3/14 (2006.01)

(52) **U.S. Cl.** **271/97**; 271/98

(58) **Field of Classification Search** 271/97, 271/98; 347/104
See application file for complete search history.

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(74) *Attorney, Agent, or Firm*—Canon USA Inc IP Div

(57) **ABSTRACT**

A feeding unit is detachably attached to a sheet cassette in which sheets are loaded. The feeding unit includes a sheet tray on which sheets are loaded, and a fan for blowing air against the side surface of a stack of sheets loaded on the sheet tray, the sheet tray and the fan being held in a case.

8 Claims, 14 Drawing Sheets

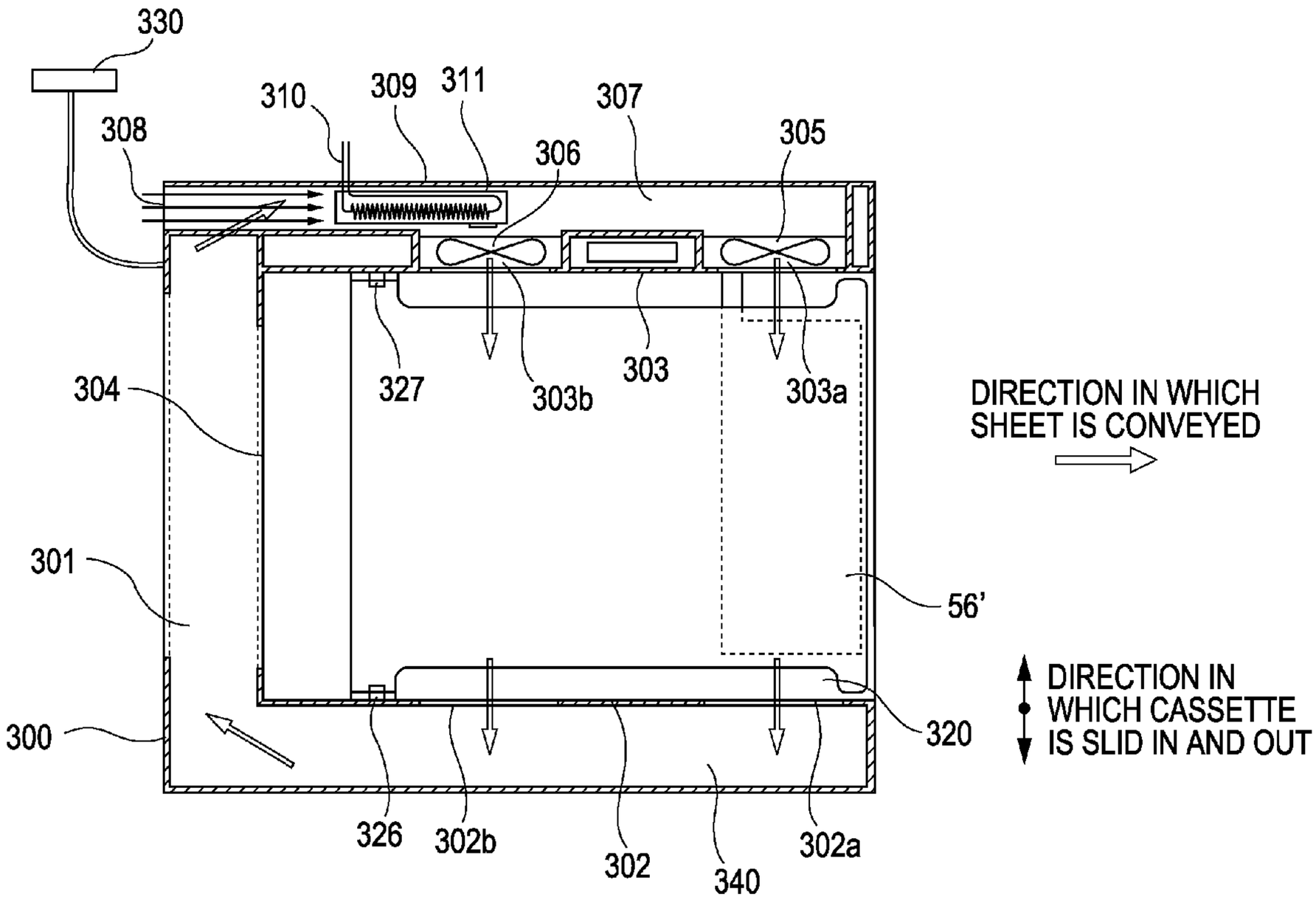


FIG. 1

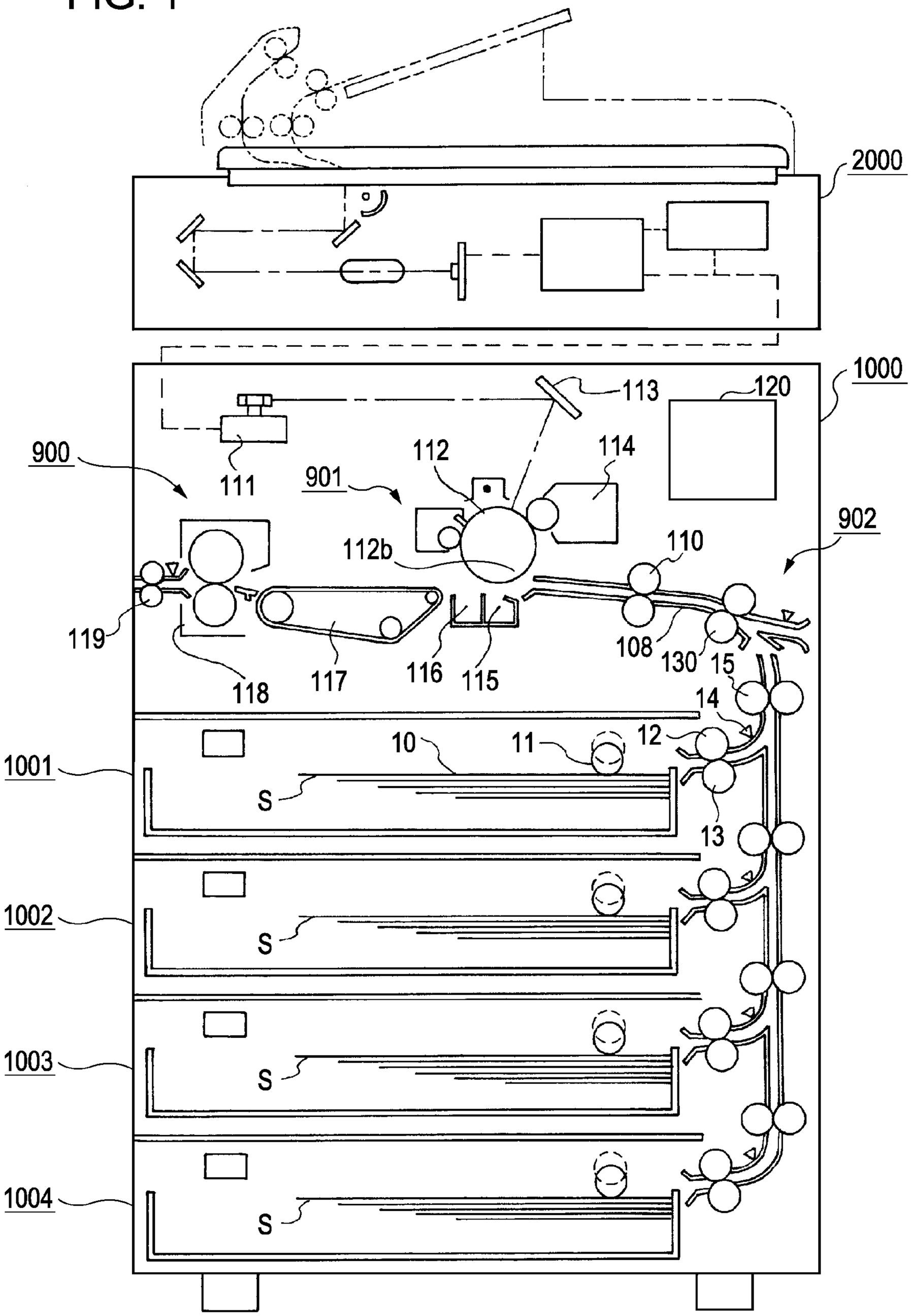
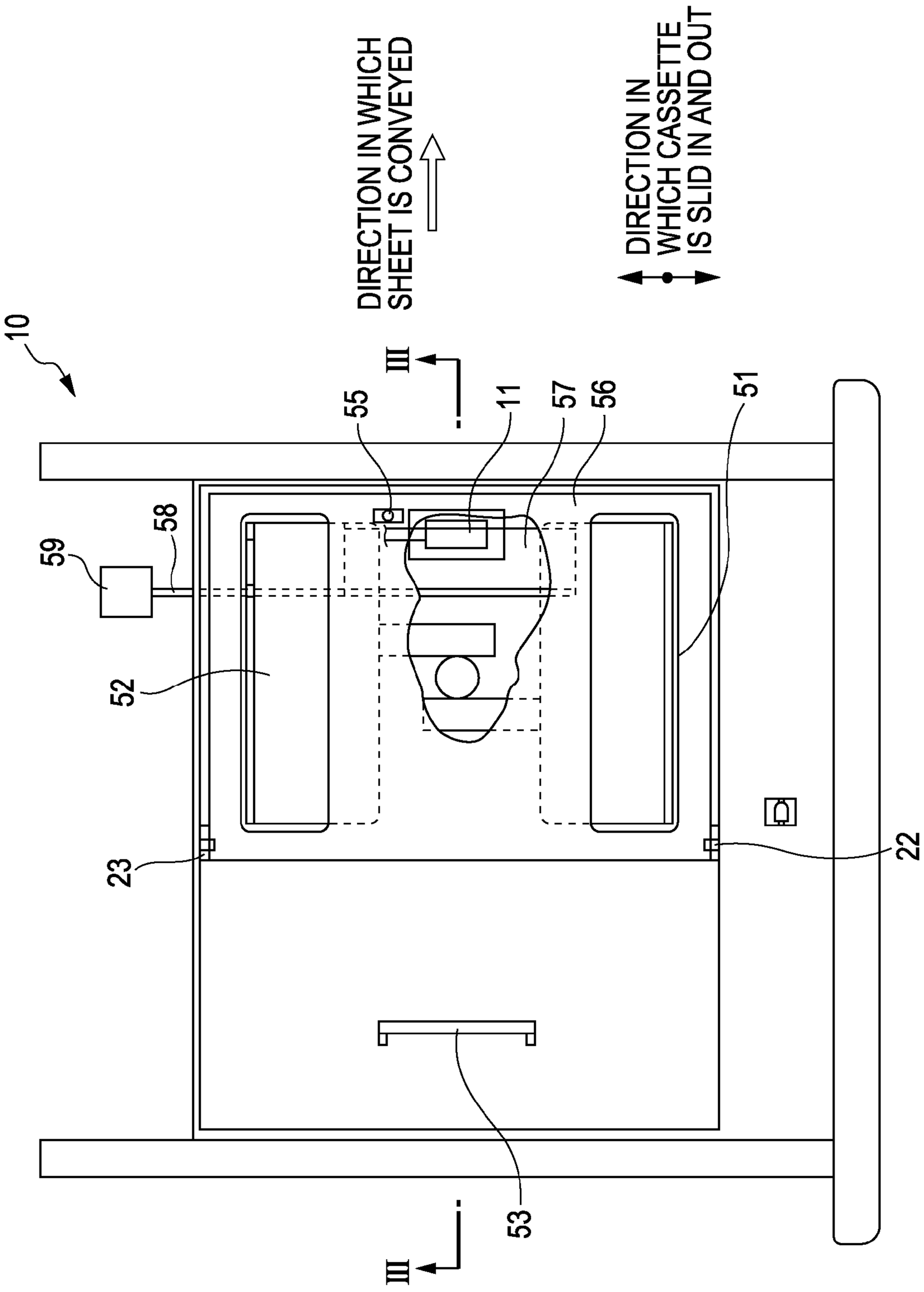

2000
1000
113
120
900
111
901
112
114
902
112b
110
119
118
117
116
115
108
130
15
14
12
10
11
1001
S
13
1002
S
1003
S
1004
S

FIG. 2


DIRECTION IN WHICH SHEET IS CONVEYED
DIRECTION IN WHICH CASSETTE IS SLID IN AND OUT
10
III
55
11
57
56
51
58
59
52
23
22
53
III

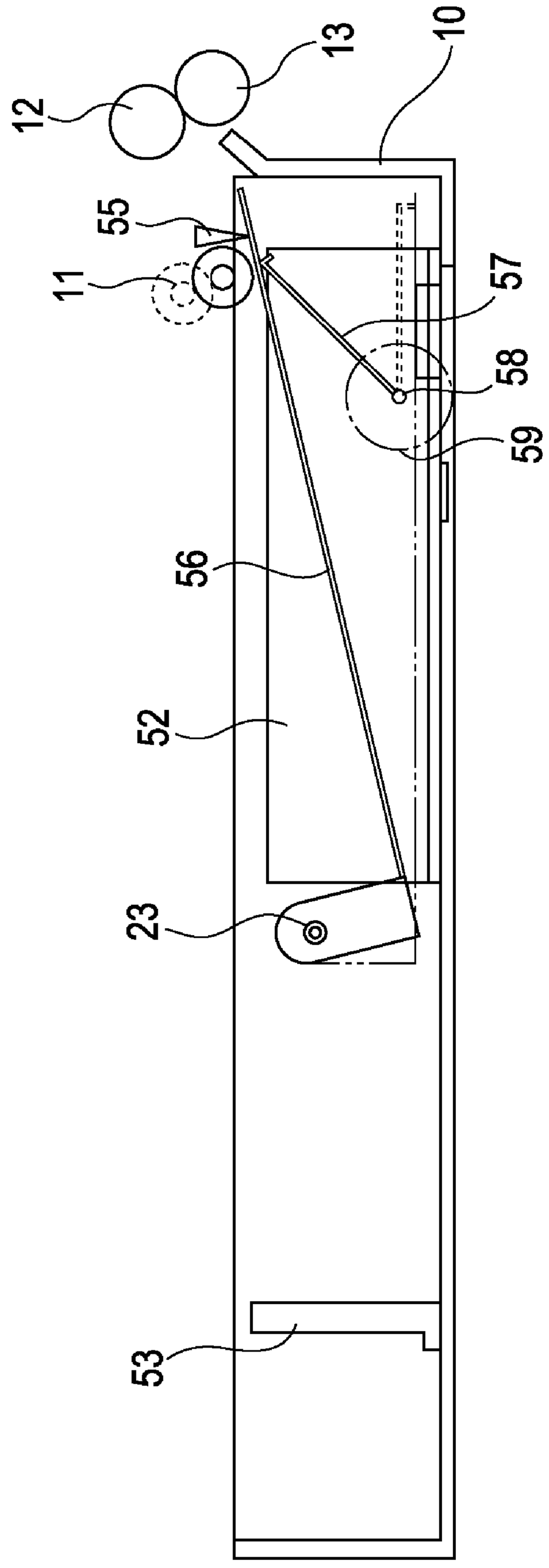


FIG. 3

FIG. 4

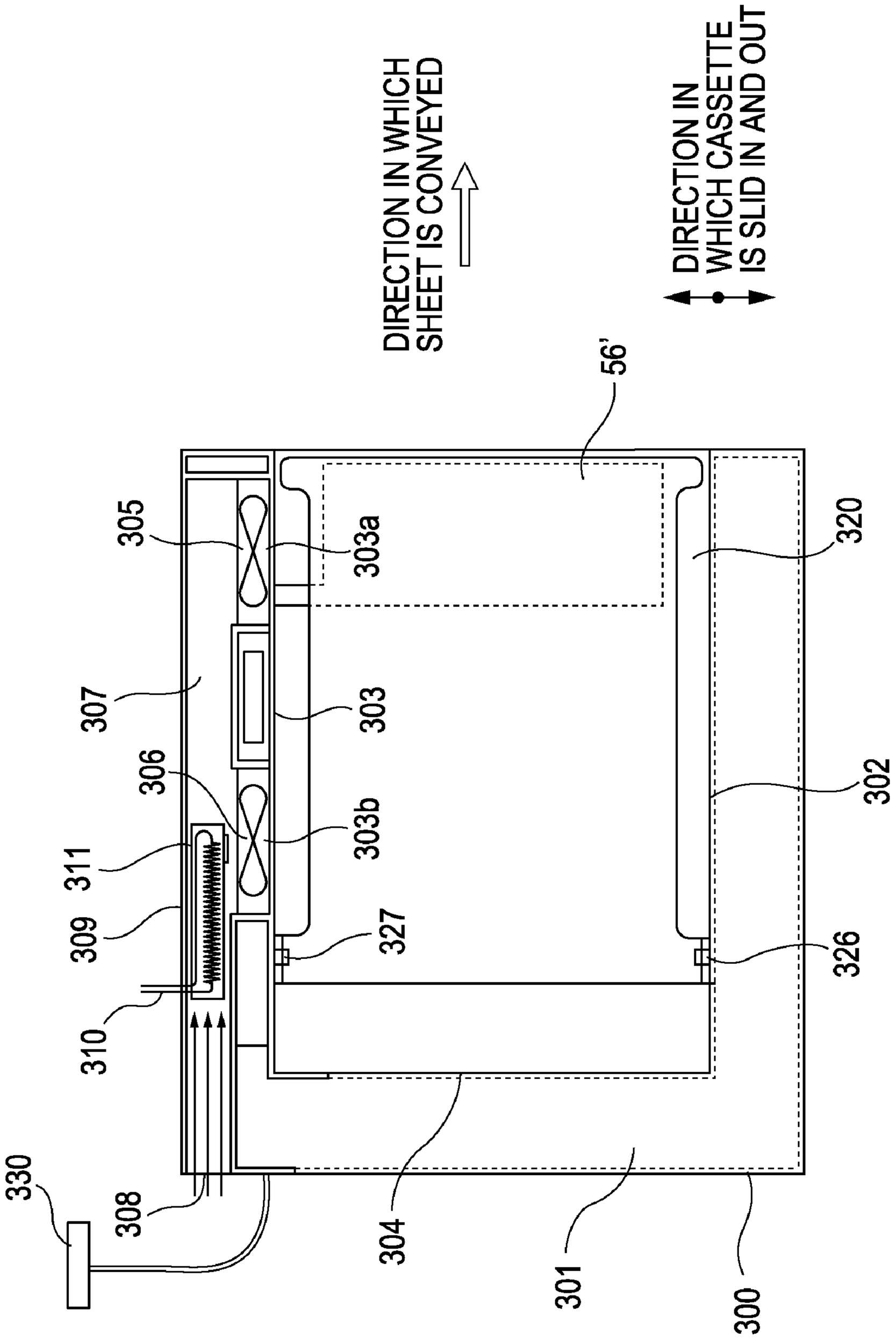

DIRECTION IN WHICH SHEET IS CONVEYED
DIRECTION IN WHICH CASSETTE IS SLID IN AND OUT
56'
305
303a
320
307
303
306
303b
302
311
309
327
326
310
330
308
304
301
300

FIG. 5

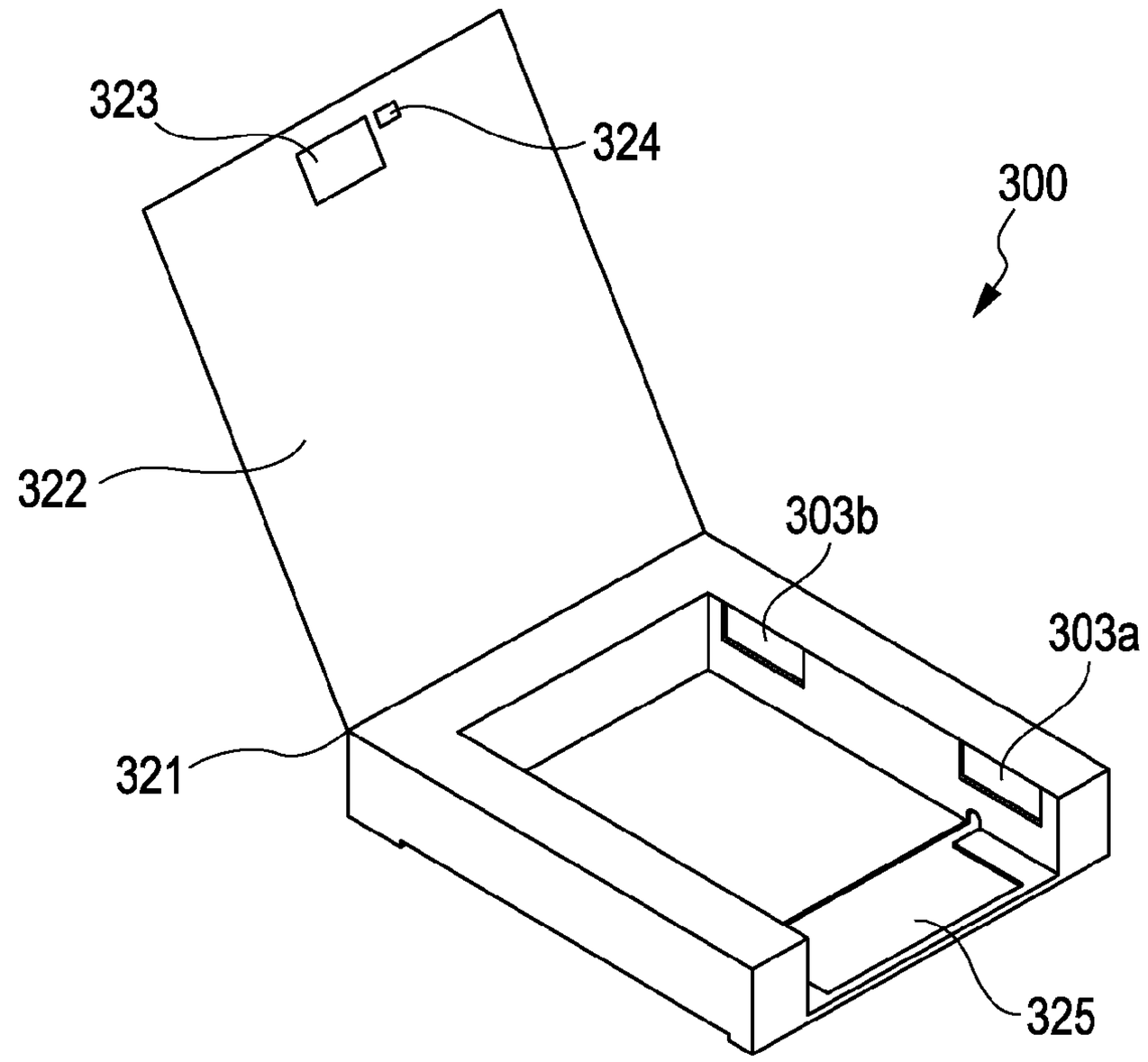


FIG. 6

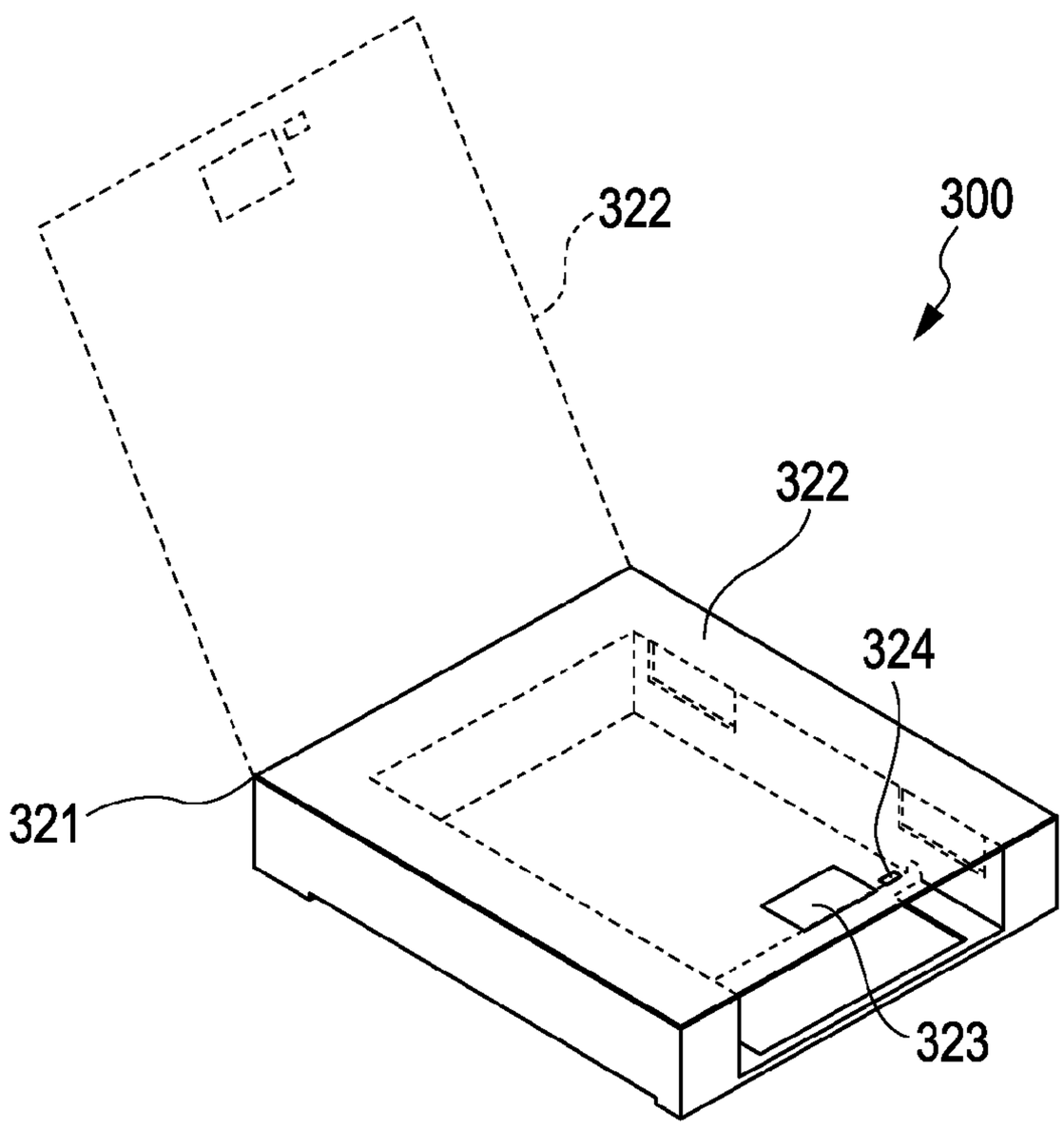


FIG. 7

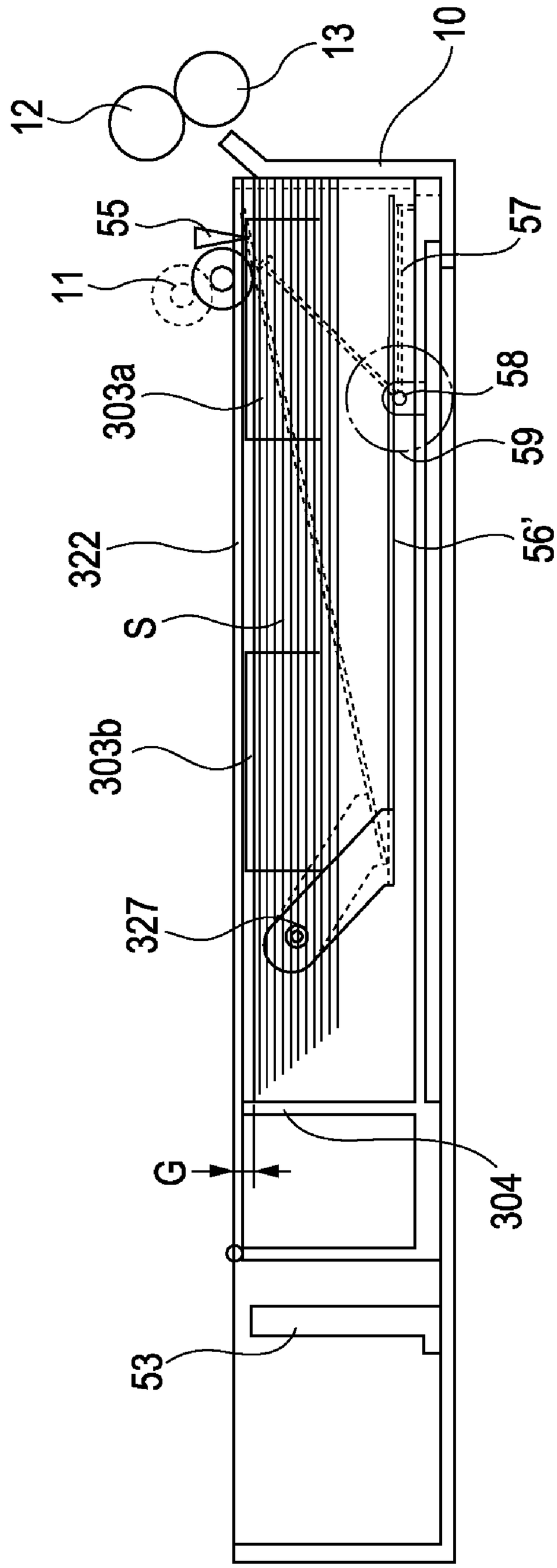
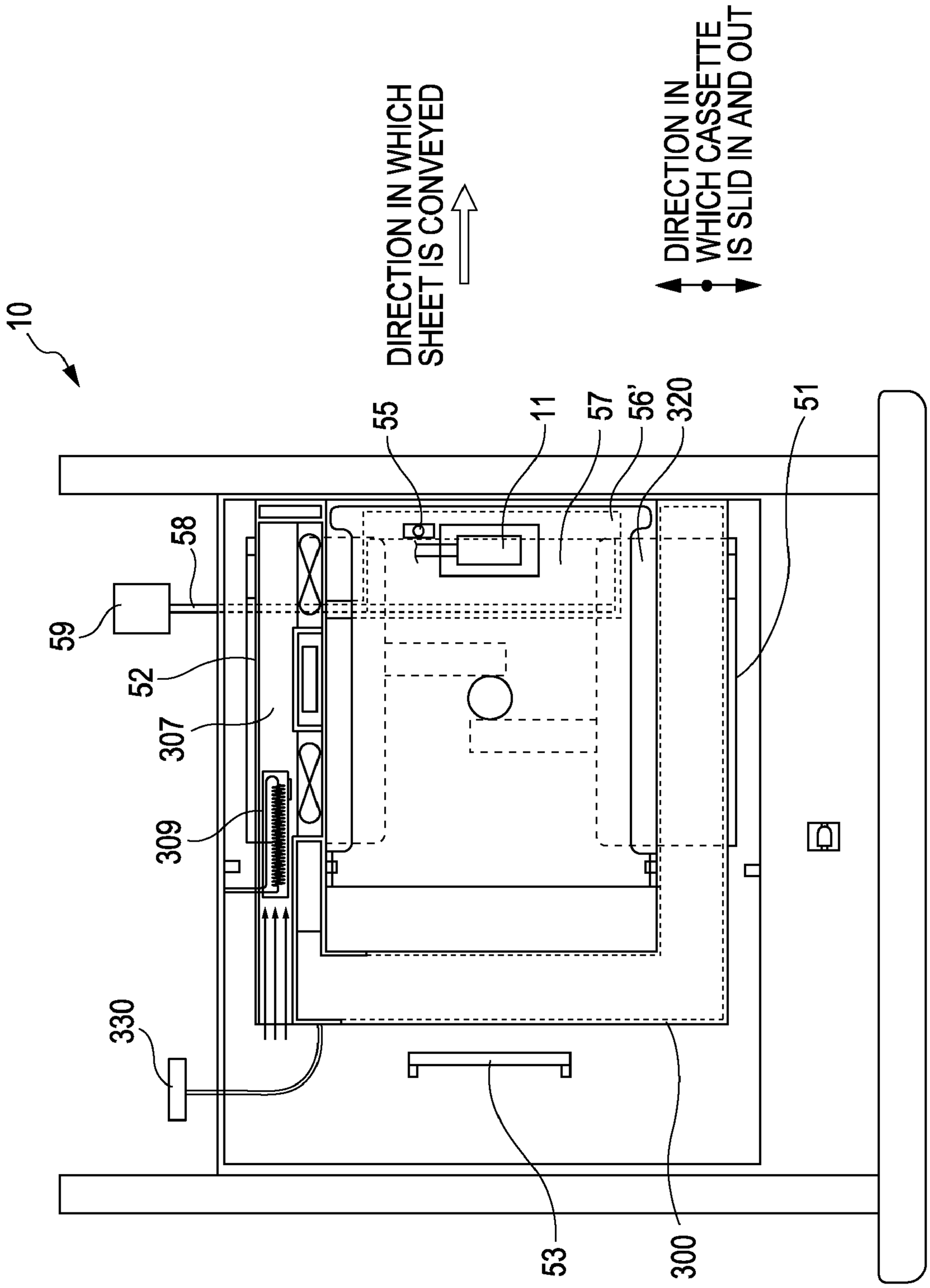


FIG. 8


10
DIRECTION IN WHICH SHEET IS CONVEYED
DIRECTION IN WHICH CASSETTE IS SLID IN AND OUT
55
11
57
56'
320
51
58
59
52
307
309
330
53
300

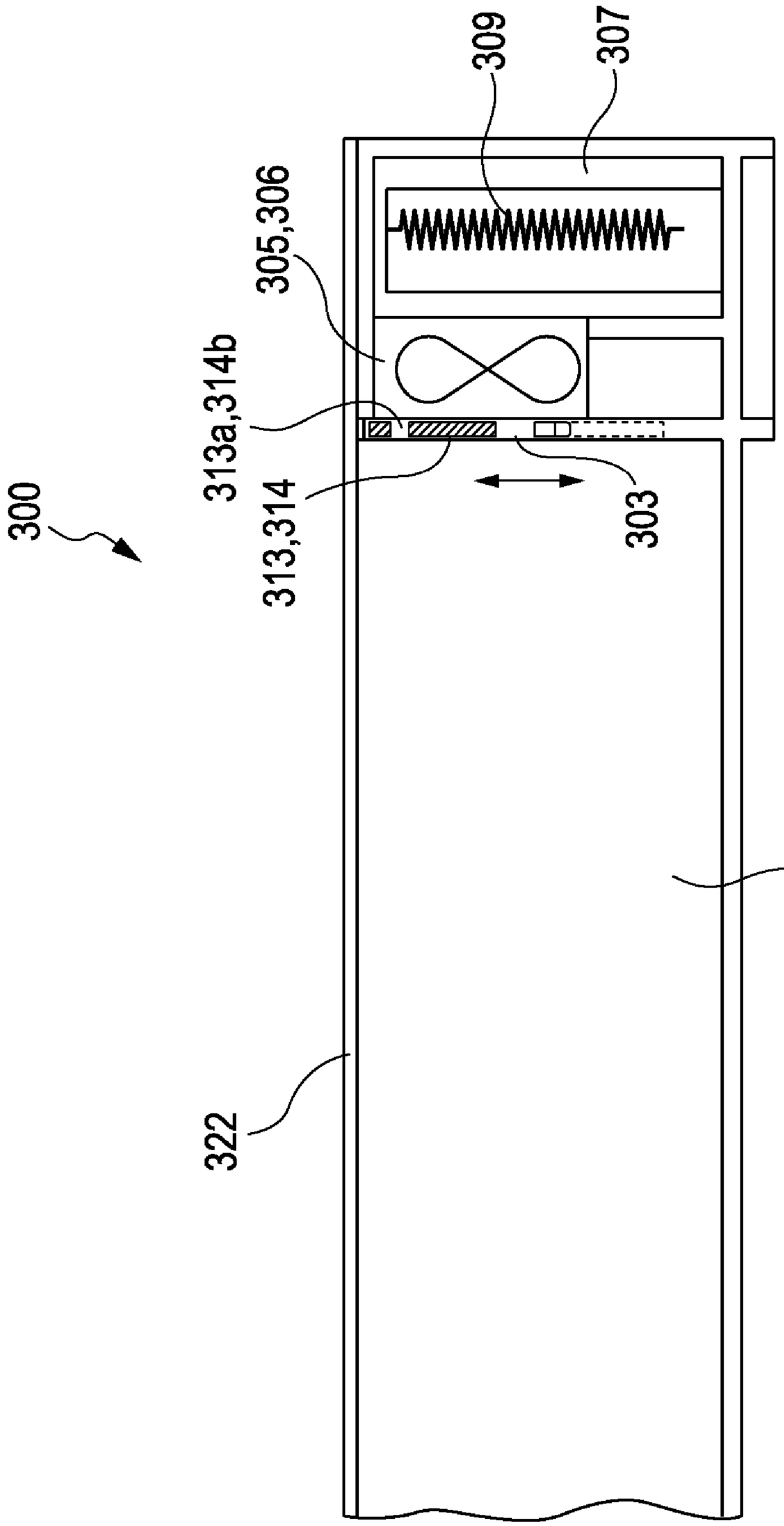


FIG. 9

FIG. 10

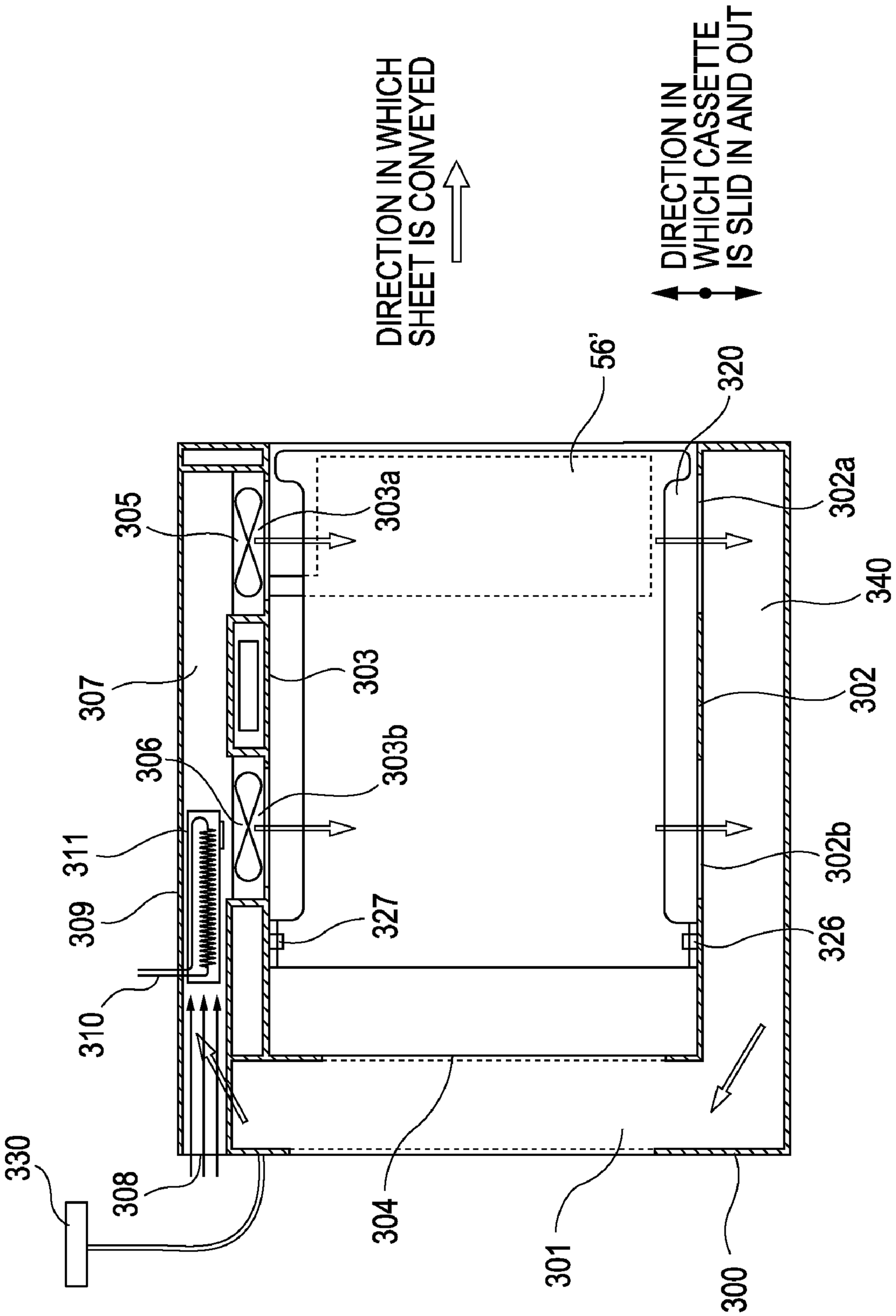

DIRECTION IN WHICH SHEET IS CONVEYED
DIRECTION IN WHICH CASSETTE IS SLID IN AND OUT
56'
320
305
303a
302a
340
307
303
302
306
303b
311
309
327
302b
326
310
330
308
304
301
300

FIG. 11

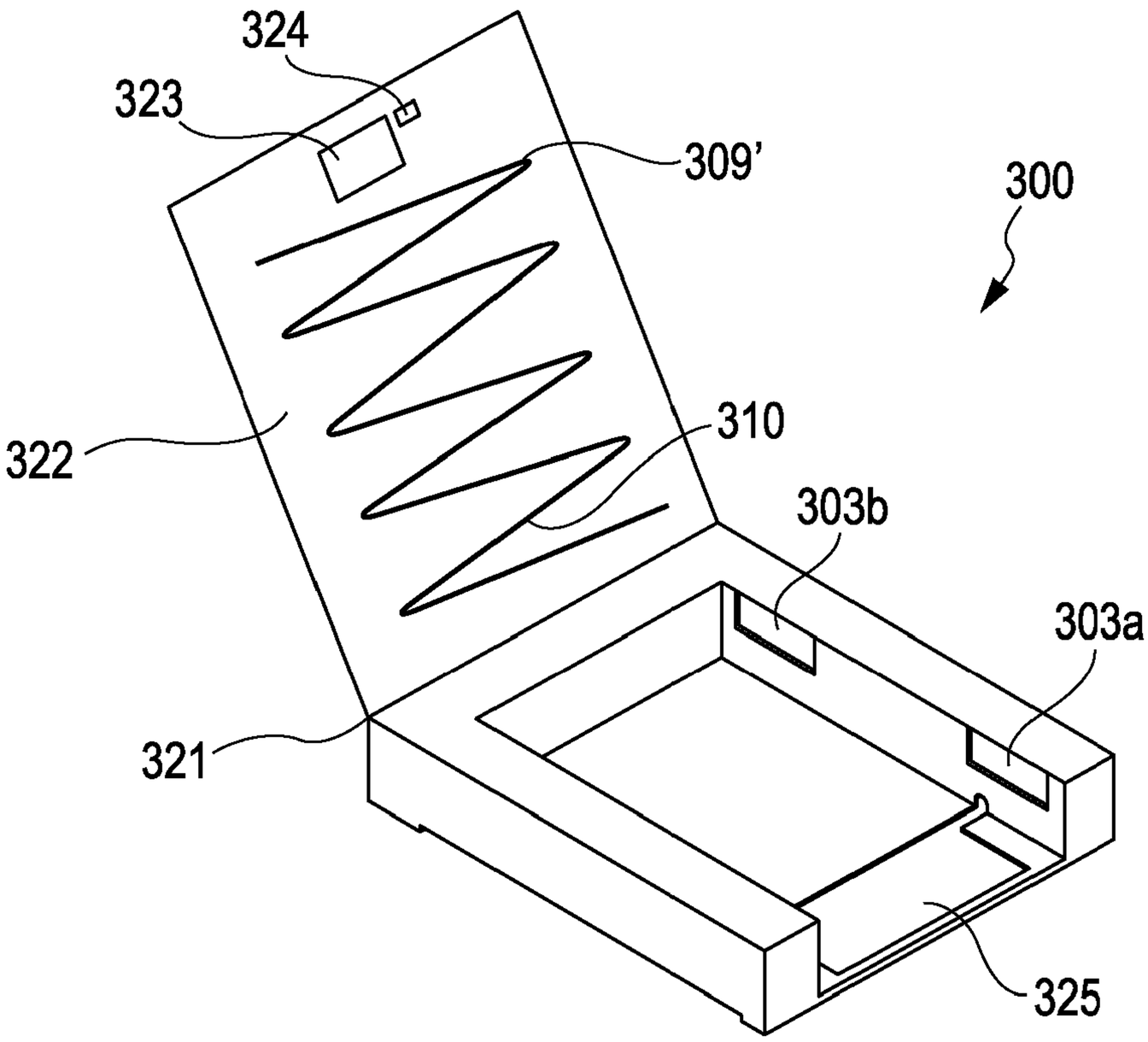

324
323
309'
300
322
310
303b
303a
321
325

FIG. 12

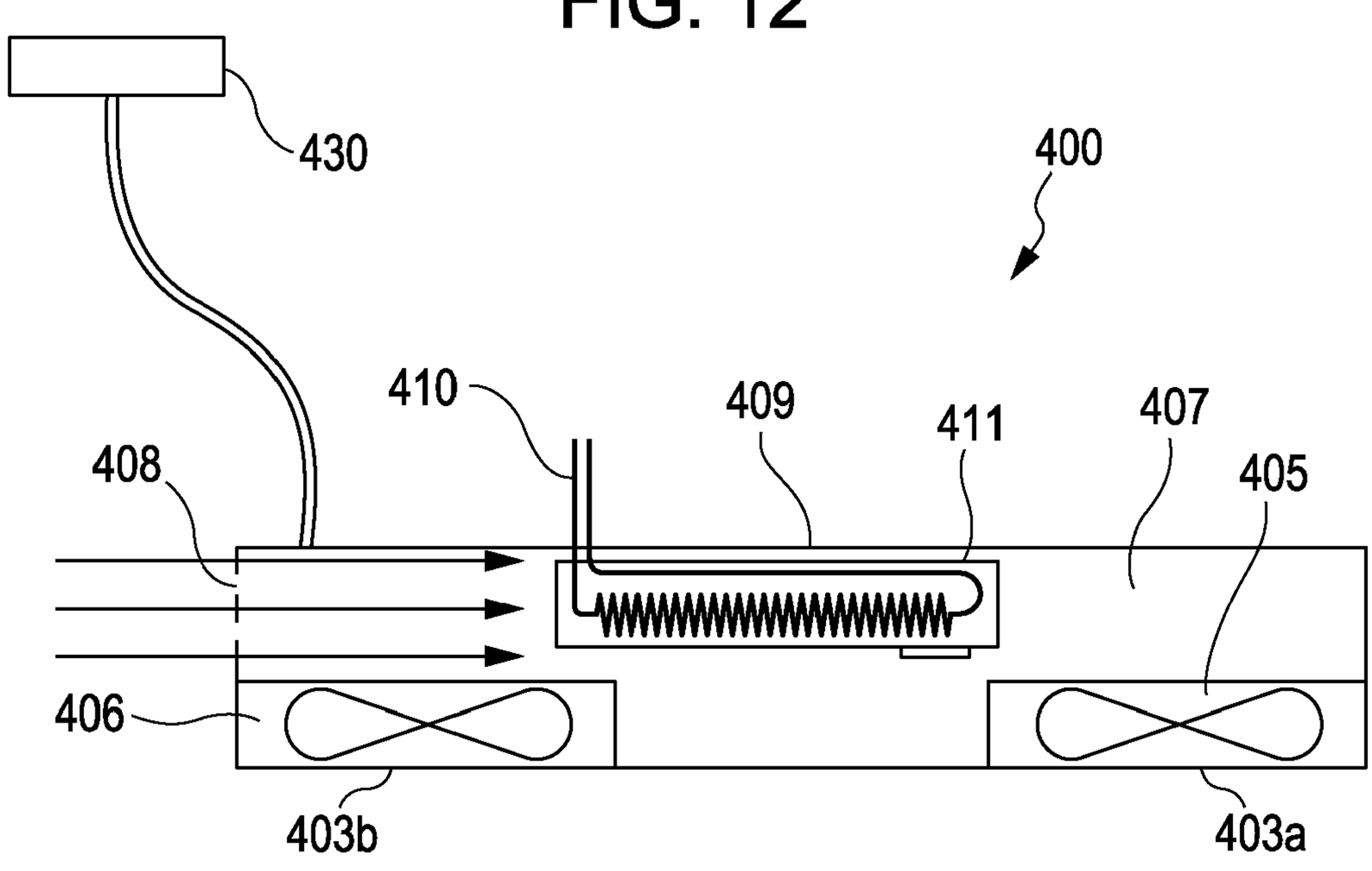

430
400
410
409
411
407
405
408
406
403b
403a

FIG. 13

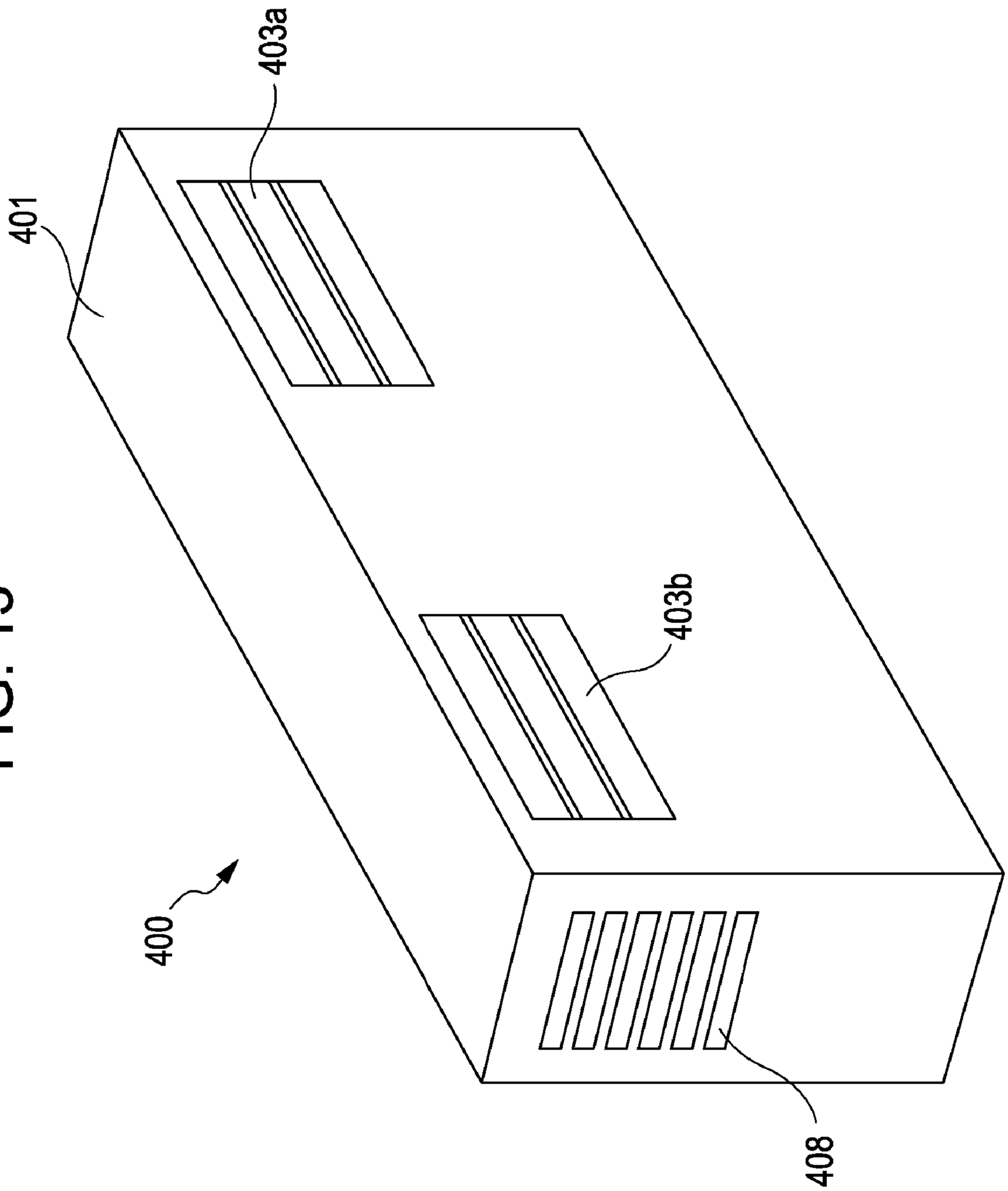


FIG. 14

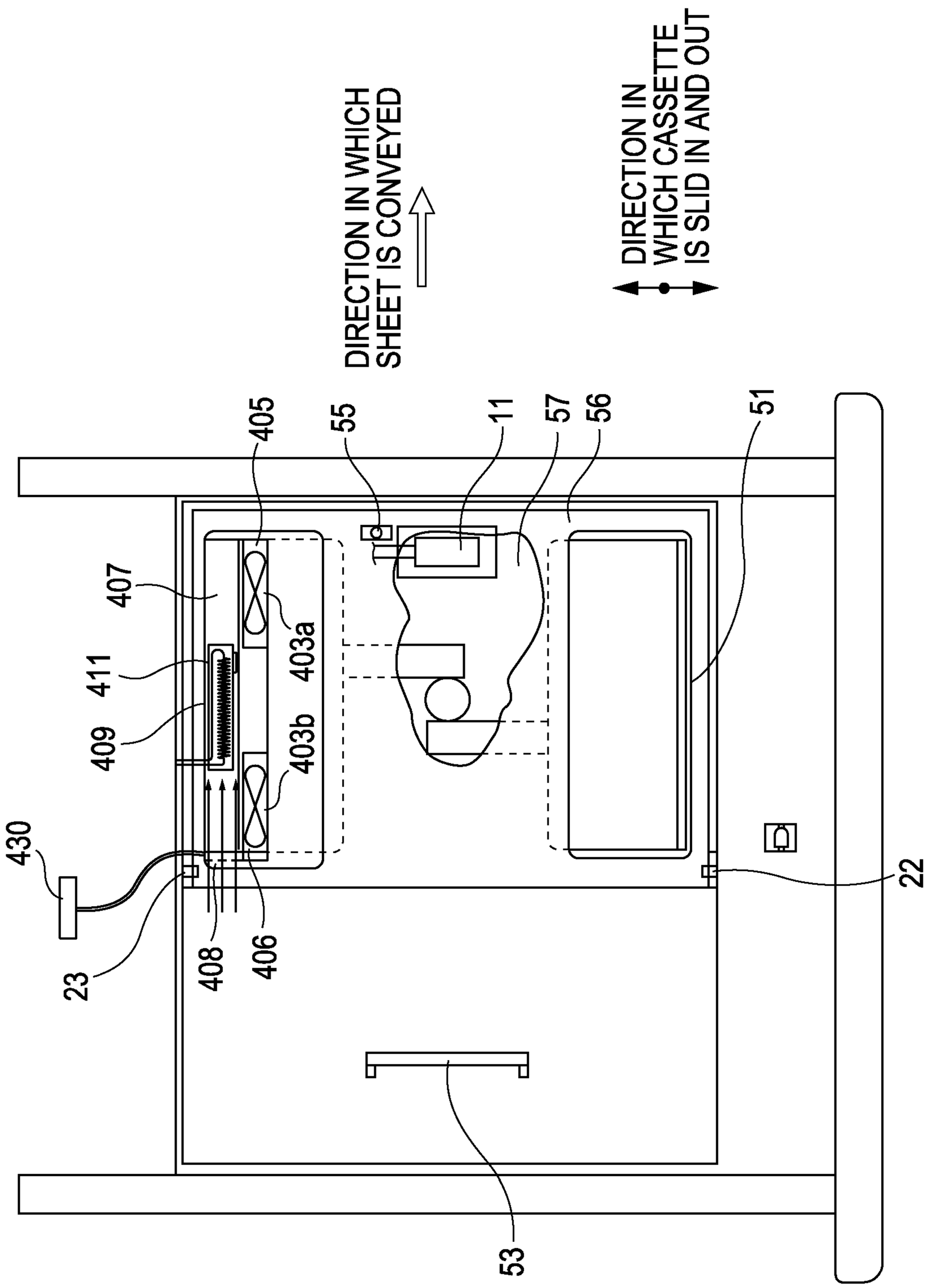
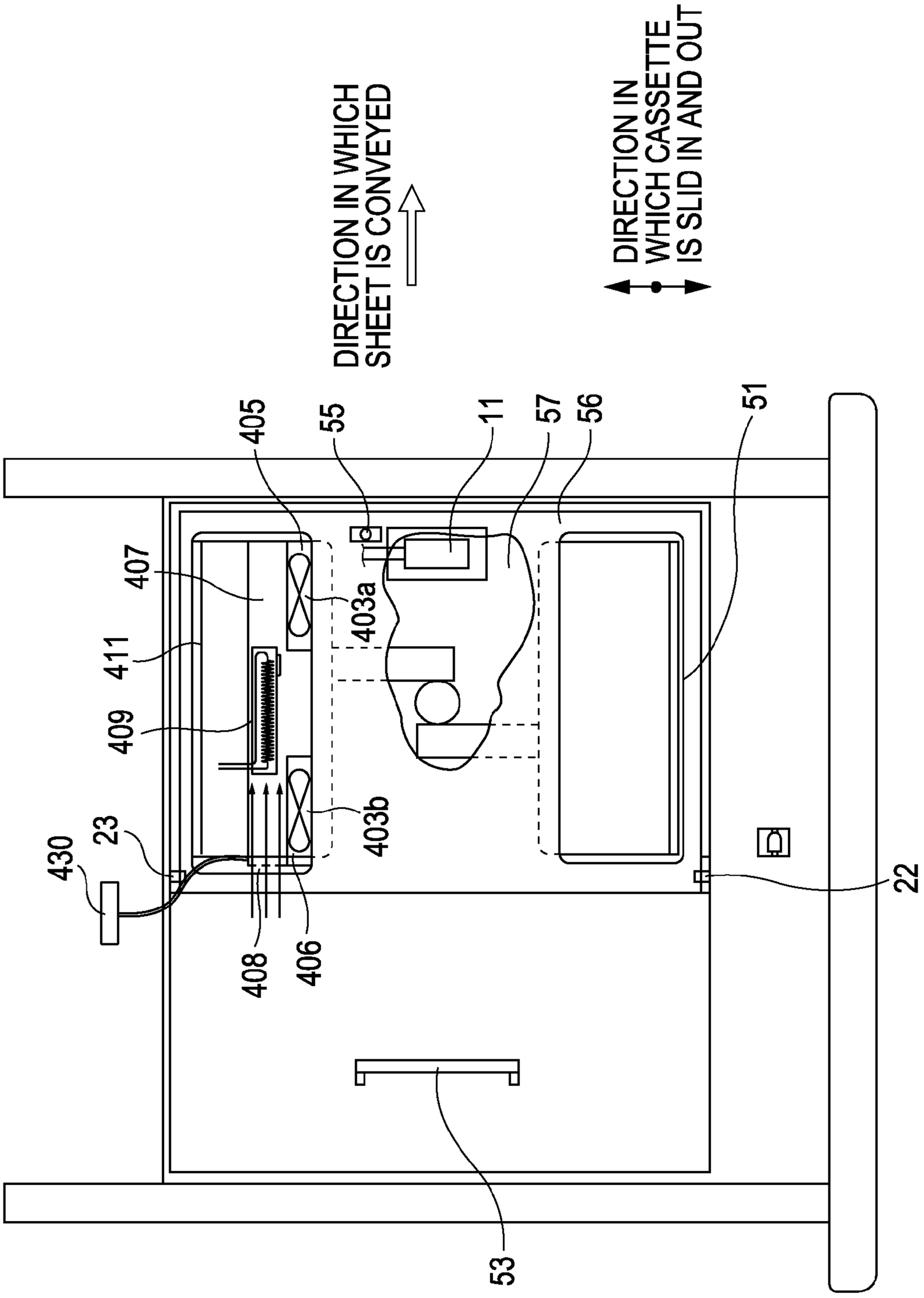

DIRECTION IN WHICH SHEET IS CONVEYED
DIRECTION IN WHICH CASSETTE IS SLID IN AND OUT
405
55
11
57
56
51
407
411
409
403a
403b
430
22
23
408
406
53

FIG. 15


DIRECTION IN WHICH SHEET IS CONVEYED
DIRECTION IN WHICH CASSETTE IS SLID IN AND OUT
405
55
11
57
56
51
407
403a
411
409
403b
23
430
408
406
22
53

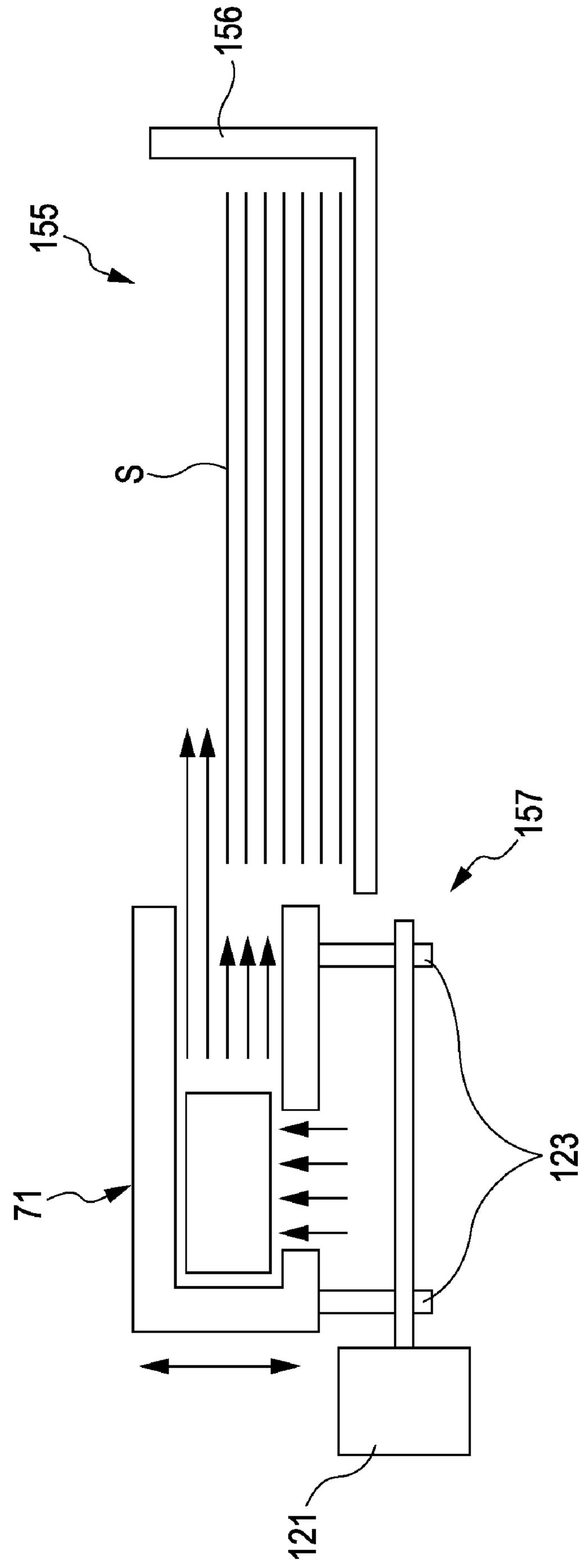


FIG. 16
PRIOR ART

SHEET FEEDING UNIT, SHEET FEEDING APPARATUS, AND IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/466,557, filed Aug. 23, 2006, which claims the benefit of Japanese Application No. 2005-249276 filed Aug. 30, 2005 and No. 2005-304258 filed Oct. 9, 2005, all of which are hereby incorporated by reference herein in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a sheet feeding unit, a sheet feeding apparatus, and an image forming apparatus for one-by-one feeding sheets that tend to stick to each other.

2. Description of the Related Art

In image forming apparatuses such as photocopiers and printers, cut sheets of paper that can be continuously fed are normally limited to sheets of high-quality paper and normal paper designated by photocopier manufacturers. In order to separate and feed such sheets one-by-one, various frictional separation techniques, for example, a retard roller separation technique and a separation pad technique have been used.

The retard roller separation technique will be described. A pickup roller is in contact with the uppermost sheet of a stack of sheets. A feed roller is provided on the downstream side of the pickup roller in the sheet feeding direction. A separation roller is in contact with the feed roller and driven at a predetermined torque in the opposite direction from the sheet feeding direction. Of the sheets sent out by the pickup roller, only one sheet passes the nip between the feed roller and the separation roller. Thus, double feeding is prevented.

In the separation pad technique, a friction member is pressed against a feed roller at a predetermined pressure, and only one sheet passes through the nip therebetween. Thus, double feeding is prevented.

For example, in the case of the retard roller separation technique, sheets can be fed one by one, by appropriately setting the torque and pressure of the separation roller in consideration of the frictional force between the sheets.

In accordance with the diversification of recording media, there is an increasing demand to form an image on, for example, a sheet of very heavy paper, an overhead projector (OHP) sheet, and a sheet of art film. In addition, in accordance with a growing need for color printing, there is also an increasing demand to form an image on a sheet of coated paper having a surface coated to increase whiteness or glossiness.

However, in the case of sheets that are formed of a resin material that tends to be electrically charged, such as OHP sheets and sheets of art film, in a dry environment, the surfaces of the sheets are gradually charged due to friction therebetween during a feeding operation. Therefore, due to the Coulomb force, the sheets can stick to each other. Therefore, failure in pickup or double feeding can occur.

In the case of coated paper, under high humidity, the sheets can stick to each other. Therefore, in the conventional separation techniques, failure in pickup or double feeding can occur. This is because, in the conventional separating techniques, only the frictional force between sheets is considered.

In the case of the above special sheets, the frictional force between sheets is equal to or less than that of normal paper.

However, the adhesive force between resin sheets due to frictional charge in a dry environment and the adhesive force between sheets of coated paper under high humidity are much higher than the frictional force between the sheets. Therefore, in the conventional separation techniques, such special sheets can fail to be separated.

To eliminate the above-described strong adhesion between sheets, there is proposed a sheet feeding apparatus having an auxiliary air adhesion eliminating device that blows air against a stack of sheets from the side. This apparatus blows air against a stack of sheets from the side, thereby eliminating adhesion between the sheets in advance. After the adhesion between the sheets is eliminated, a pickup roller sends out the sheets. A separating section provided on the downstream side of the pickup roller separates one sheet from the other. This apparatus is used in the print industry and some photocopiers.

Unlike generally used apparatuses that use only the frictional separation technique, the feeding apparatus having an auxiliary air adhesion eliminating device can separate even the above highly adhesive sheets because it eliminates adhesion before feeding. Concerning such a feeding technique using an auxiliary air adhesion eliminating device, many proposals have been made, for example, Japanese Patent Laid-Open No. 11-005643 (corresponding to U.S. Pat. No. 6,015,144).

FIG. **16** shows an example of a sheet feeding apparatus **155** having an auxiliary air adhesion eliminating device. This sheet feeding apparatus **155** includes a feed tray **156** in which sheets S are loaded, and a sheet feeding device (not shown) that sends out sheets from the feed tray **156**. The sheet feeding apparatus **155** further includes an air blowing device **71** serving as an auxiliary air adhesion eliminating device. The air blowing device **71** blows air against the side and over the top of the stack of sheets from the direction perpendicular to the side surface of the stack.

The sheet feeding apparatus **155** further includes an airflow moving device **157**, which includes an electric motor **121** and cam plates **123**. The motor **121** rotates the cam plates **123** so as to vertically move the air blowing device **71**. Thus, the airflow is vertically moved.

Japanese Patent Laid-Open No. 2001-48366 discloses an apparatus including an auxiliary hot-air adhesion eliminating device capable of drying sheets by blowing air heated with a heater. This can weaken the adhesive force particularly between sheets of coated paper under high humidity.

However, the above sheet feeding apparatus using an auxiliary air adhesion eliminating device or an auxiliary hot-air adhesion eliminating device requires devices such as an air blowing device, a heater device, and an electric motor. Therefore, such a sheet feeding apparatus has been used in a relatively large feeding deck whose capacity is 2000 to 4000 sheets. Therefore, when being applied to apparatuses such as a photocopier, the feeding apparatus can be applied only to high-speed and high-class models to which a large feeding deck can be attached.

Therefore, the feeding apparatus cannot be applied to relatively low and medium class models to which a large feeding deck cannot be attached, and models for office use whose

installation space is limited. If such models use highly adhesive sheets, the sheets can fail to be separated and double feeding can occur.

SUMMARY OF THE INVENTION

The present invention is directed to a sheet feeding apparatus that makes it possible to apply the air adhesion elimination to, for example, image forming apparatuses for office use.

In an aspect of the present invention, a sheet feeding apparatus for feeding sheets includes a sheet cassette and a sheet feeding unit. Sheets are loaded in the sheet cassette. The sheet feeding assisting unit is detachably attached to the sheet cassette and includes an air blowing mechanism operable to blow air against the edges of sheets to be fed.

In another aspect of the present invention, an image forming apparatus that forms an image on a sheet includes a sheet cassette, a sheet feeding assisting unit, a sheet feeding member, and an image forming section. Sheets are loaded in the sheet cassette. The sheet feeding assisting unit is detachably attached to the sheet cassette and includes an air blowing mechanism operable to blow air against the edges of sheets to be fed. The sheet feeding member feeds the sheets loaded in the sheet cassette. The image forming section is configured to form an image on a sheet fed by the sheet feeding member.

Further features of the present invention will become apparent from the following description of exemplary embodiments (with reference to the attached drawings).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of a printer that is an example of an image forming apparatus having a sheet feeding apparatus according to a first embodiment of the present invention.

FIG. **2** is a plan view showing the structure of the sheet cassette shown in FIG. **1**.

FIG. **3** is a sectional view of the sheet cassette shown in FIG. **1**.

FIG. **4** is a plan view of a sheet feeding unit to be installed in the sheet cassette.

FIG. **5** is a perspective view of the sheet feeding unit with the top lid open.

FIG. **6** is a perspective view of the sheet feeding unit with the top lid closed.

FIG. **7** is a sectional view of the sheet cassette installed with the sheet feeding unit.

FIG. **8** is a plan view of the sheet cassette installed with the sheet feeding unit.

FIG. **9** shows a section of the sheet feeding unit viewed from the right side.

FIG. **10** is a plan view of a sheet feeding unit according to a second embodiment.

FIG. **11** is a perspective view of a sheet feeding unit whose top lid is provided with an air heating device.

FIG. **12** is a plan view of an air blowing apparatus according to a third embodiment.

FIG. **13** is a perspective view of the air blowing apparatus shown in FIG. **12**.

FIG. **14** is a plan view of a sheet cassette installed with the air blowing apparatus.

FIG. **15** is a plan view of a sheet cassette installed with the air blowing apparatus.

FIG. **16** is an explanatory view of a conventional sheet feeding apparatus.

DESCRIPTION OF THE EMBODIMENTS

The embodiments of the present invention will now be described with reference to the drawings.

Image Forming Apparatus

FIG. **1** is a sectional view of an image forming apparatus to which a sheet feeding apparatus according to a first embodiment is attached.

First, the overall structure of the image forming apparatus will be described. Reference numeral **900** denotes the image forming apparatus of this embodiment. In the upper part of the apparatus body, a scanner section **2000** is disposed. The scanner section **2000** optically reads the document information.

In the lower part of the apparatus body, four sheet feeding apparatuses **1001** to **1004** are disposed. The apparatuses **1001** to **1004** feed sheets to an image forming section **901**. The image forming apparatus **900** further includes a sheet conveying apparatus **902** and a controller **120**. Sheets S sent out from the sheet feeding apparatuses **1001** to **1004** are conveyed to the image forming section **901** by the sheet conveying apparatus **902**. The controller **120** controls the image forming apparatus **900**.

The sheet conveying apparatus **902** includes a conveying roller pair **15**, a preliminary register roller pair **130**, a register roller pair **110**, and a sheet conveying path **108** composed of guide plates. A sheet S sent out from one of the sheet feeding apparatuses **1001** to **1004** is caused to pass along the sheet conveying path **108** by the conveying roller pair **15**, and is then guided to the register roller pair **110**. Next, the sheet S is conveyed to the image forming section **901** by the register roller pair **110**.

The image forming section **901** includes a photosensitive drum **112**, a laser scanner **111**, a developer **114**, a transfer charger **115**, and a separation charger **116**. When an image is formed, laser light from the laser scanner **111** is reflected by a mirror **113** onto the photosensitive drum **112**, which rotates clockwise, and a latent image is thereby formed on the photosensitive drum **112**. The latent image formed on the photosensitive drum **112** is then converted into a visible toner image by the developer **114**.

The toner image on the photosensitive drum **112** is then transferred onto the sheet S by the transfer charger **115** in a transferring section **112***b*. The sheet S with the transferred toner image thereon is separated from the photosensitive drum **112** by the separation charger **116**, and is then conveyed by a conveying belt **117** to a fixing device **118**, in which the toner image is fixed. Next, the sheet S is discharged by a discharging roller pair **119** onto a discharged paper tray or into an after-treatment device (both not shown).

The image forming apparatus **900** of this embodiment has four sheet feeding apparatuses **1001** to **1004** that feed sheets to the image forming section **901**. The four sheet feeding apparatuses **1001** to **1004** have the same structure. Therefore, only the sheet feeding apparatus **1001** will be described.

First Exemplary Embodiment

As shown in FIG. **1**, the sheet feeding apparatus **1001** of the first embodiment includes a pickup roller **11** and a separating section. The pickup roller **11** serves as a sheet feeding member that feeds sheets S loaded in a sheet cassette **10**. The separating section includes a feed roller **12** and a retard roller **13** that rotates in the opposite direction from the feed roller

12. The pickup roller **11** moves up and down and rotates at a predetermined time. The sheets S in the sheet cassette **10** are separated and fed one at a time by the pickup roller **11** and the separating section. A feed sensor **14** is provided on the downstream side and in the vicinity of the feed roller **12** and the retard roller **13**. This feed sensor **14** can detect the passage of the sheet S.

The sheet cassette **10** is detachably attached to the sheet feeding apparatus **1001**. When sheets that are hard to separate are used, a hereinafter-described sheet feeding unit is attached to the sheet cassette **10**, and the sheets are loaded in the sheet feeding unit. However, when normal paper is used, the sheet feeding unit is not attached to the sheet cassette **10**, and the sheets are loaded in the sheet cassette **10**.

First, the sheet cassette **10** will be described with reference to FIGS. **2** and **3**. FIG. **2** is a plan view showing the structure of the sheet cassette **10**, and FIG. **3** is a sectional view thereof. Cassette chambers are provided in the image forming apparatus **900**. In this embodiment, the sheet cassette **10** can be slid in and out of one of the cassette chambers in the width direction perpendicular to the sheet feeding direction (perpendicularly to the drawing plane in FIG. **1**).

In FIG. **2**, reference numerals **51** and **52** denote side positioning plates, which serve as sheet positioning devices that position the ends of the sheets loaded in the sheet cassette **10** in the width direction (the direction perpendicular to the sheet feeding direction). These side positioning plates **51** and **52** are movable in the width direction according to the size of the sheets S. Reference numeral **53** denote a rear positioning plate, which serving as a sheet restricting device that positions the rear end of the sheets S in the sheet feeding direction. This rear positioning plate **53** is movable in the sheet feeding direction according to the size of the sheets S.

The sheet cassette **10** can be pulled out along cassette rails (not shown). When a user loads sheets S, the sheet cassette **10** can be pulled out of the image forming apparatus. When the sheet cassette **10** has been loaded in the cassette chamber, a cassette sensor (not shown) detects the sheet cassette **10**. The cassette sensor sends a detection signal to the controller **120**. On the basis of the detection signal from the cassette sensor, the controller **120** can detect whether the sheet cassette **10** is loaded in the sheet feeding apparatus **1001** (see FIG. **1**) or pulled out.

As shown in FIG. **3**, a cassette tray **56** for loading sheets S is provided in the sheet cassette **10**. The cassette tray **56** is pivotably supported by supporting pins **22** and **23**. Under the cassette tray **56**, a lifter mechanism is disposed. The lifter mechanism raises and lowers the cassette tray **56**. The lifter mechanism includes a lifter plate **57**, which is in contact with the cassette tray **56** and lifts it. The lifter plate **57** is attached to a lifter drive shaft **58** and is pivotable by the driving force input from a lifter drive gear **59**.

When the sheet cassette **10** is loaded in the body, a driving source (not shown) transmits driving force to the driving gear **59**, and the lifter plate **57** thereby causes the cassette tray **56** to pivot. That is to say, the lifter plate **57** presses up the cassette tray **56** according to whether or not the sheet cassette **10** is loaded.

A sheet surface position sensor **55** is provided above the sheet cassette **10**. When the sheet cassette **10** is loaded in the apparatus body, the sensor **55** detects whether or not the top surface of a stack of sheets loaded in the cassette tray **56** is at a feedable position. Driving force is transmitted to the driving gear **59** so that the top surface of the stack of sheets loaded in the cassette tray **56** keeps at an appropriate position.

With the feeding of the sheets, the sheets S are sequentially sent out from the top, and the top surface of the stack of sheets gradually lowers. When the sheet surface position sensor **55** is turned OFF, the controller **120** drives the lifter motor so that the cassette tray **56** rises. In this way, the level of the top surface of the stack of sheets can be kept within a certain range. This is the structure of the sheet cassette **10** in the case where normal paper is used.

Next, the case where sheets that a normal sheet cassette **10** tends to double-feed, such as heavy paper and coated paper, are used will be described with reference to FIGS. **4** to **8**.

When such sheets are used, in this embodiment, a sheet feeding assisting unit is installed in the sheet cassette **10**, and the sheets are loaded in this sheet feeding unit. Next, the sheet cassette **10** is loaded in the image forming apparatus body, and the sheets are fed from the sheet feeding assisting unit.

FIG. **4** is a plan view showing the structure of a sheet feeding assisting unit **300** for feeding special sheets difficult to separate, such as heavy paper and coated paper.

The sheet feeding assisting unit **300** has a case **301**. The case **301** has inner walls **302** and **303** in the width direction of the sheets and an inner wall **304** at the rear end in the feeding direction. The inner walls **302**, **303**, and **304** form a sheet loading space **320** whose shape and size are set according to the size of paper, such as A4 and B4.

In the sheet loading space **320**, a sheet tray **56'** is pivotably supported by supporters **326** and **327**.

In order to blow air between sheets sticking to each other, a plurality of (two in this embodiment) blowing ports (openings) **303***a* and **303***b* are provided along the back inner wall **303** in the sheet width direction at predetermined intervals. The blowing ports **303***a* and **303***b* face at least the side of the sheet S located at the feedable position. The blowing ports **303***a* and **303***b* communicate with a duct **307**. In the duct **307**, fans **305** and **306** are provided. The fans **305** and **306** serve as air blowing mechanisms. The fans **305** and **306** blow air against the side surface of the stack of sheets loaded in the sheet loading space **320** through the blowing ports **303***a* and **303***b*.

In the vicinity of an air intake **308** of the duct **307**, an air heating mechanism **309** is provided. The air heating mechanism **309** includes a heater **310** and a heat sink **311**. Air taken in through the air intake **308** is heated by the air heating mechanism **309** and then blown out through the vents **303***a* and **303***b*.

As shown in FIGS. **5** to **7**, the sheet feeding assisting unit **300** of this embodiment is provided with a top lid (openable cover) **322**. The top lid **322** covers the sheet loading space **320** and openable by a hinge **321**. When the top lid **322** is closed, a predetermined distance G is set between the top lid **322** and the uppermost sheet. The top lid **322** is provided with holes **323** and **324** so as not to be interfered with by the pickup roller **11** and the sheet surface position sensor **55**, respectively. Therefore, the closed top lid **322** does not interfere with the sheet feeding.

If air lifts up the top lid **322** and leaks from the sheet loading space **320**, the sheet separation is hindered. In order to prevent this, when the top lid **322** is closed, the top lid **322** is locked by a locking device (not shown). In order to prevent air leakage, the top lid **322** may be fastened to the case **301** using Velcro (hook and loop fastener) or a sealing member such as Moltopren.

In the bottom of the sheet loading space **320** of the sheet feeding assisting unit **300**, a hole **325** for passing the lifter plate **57** is formed. The lifter plate **57** passes through the hole **325** to be in contact with the sheet tray **56'**.

Next, the procedure to load sheets of a predetermined size into the sheet loading space **320** of the sheet feeding assisting unit **300** and to install the sheet feeding assisting unit **300**,

with the top lid **322** closed, in the sheet cassette **10** will be described with reference to FIG. **8**.

First, the cassette tray **56** is detached from the sheet cassette **10**. As shown in FIGS. **2** and **3**, the cassette tray **56** is pivotably attached to the inner wall of the sheet cassette **10** with the supporting pins **22** and **23**. Therefore, the cassette tray **56** can be easily detached by removing the supporting pins **22** and **23**. The supporting pins **22** and **23** may be molded of plastic integrally with the case. In this case, the cassette tray **56** is detached by elastically deforming the plastic.

Next, the rear positioning plate **53** and the side restricting plates **51** and **52** are moved so that the sheet feeding assisting unit **300** can be inserted. Next, as shown in FIG. **8**, the sheet feeding assisting unit **300** is placed at a predetermined position in the sheet cassette **10**. At this time, the side positioning plates **51** and **52** and the rear positioning plate **53** may be pressed against the outer wall of the sheet feeding assisting unit **300** so as to position the sheet feeding assisting unit **300** in the sheet cassette **10**.

Alternatively, the side positioning plates **51** and **52** and the rear positioning plate **53** may de detachable. In this case, after the positioning plates are detached, the sheet feeding assisting unit **300** is fitted into the sheet cassette **10**.

Finally, a connector **330** for sending and receiving electrical signals and control signals is coupled to a connecting cable (not shown) in the cassette chamber of the image forming apparatus **900**. The connecting cable is, for example, a flexible cable that maintains electrical connection even when the sheet cassette **10** is fully pulled out. Alternatively, electrical connection can be performed only when the sheet cassette **10** is loaded in the image forming apparatus body, using a drawer connector.

The lifting operation after the sheet cassette **10** is loaded in the image forming apparatus body is the same as that when normal paper is used. The lifter plate **57** comes into contact with the sheet tray **56'** and causes the sheet tray **56'** to pivot. By the detection of the sheet surface position sensor **55**, the position of the uppermost sheet is maintained substantially constant. At this time, the same lifter control as in the case where the sheet feeding assisting unit is not installed in the sheet cassette **10** is possible.

Adhesion Eliminating Operation

Next, the adhesion eliminating operation when the sheet feeding assisting unit **300** is installed in the sheet cassette **10** will be described with reference to FIG. **8**. As described above, air is blown out through the blowing ports **303***a* and **303***b* formed in the inner wall **303** so as to eliminate adhesion between the sheets. At this time, in this embodiment, the sheet loading space **320** of the sheet feeding assisting unit **300** is covered by the top lid **322**. Therefore, the sheet loading space **320** is hermetically closed, and the efficiency of adhesive elimination by the blowing of the fans **305** and **306** is dramatically improved. In addition, the efficiency of air heating by the heater **310** is also improved.

That is to say, since the sheet loading space **320** is covered by the top lid **322**, the sheet loading space **320** is a hermetically closed space having substantially the same volume as the sheets loaded therein. Therefore, air blows against the side surface of the stack of sheets substantially perpendicularly. In addition, if the air flow by the fans **305** and **306** is not strong, the air flows straight. Therefore, the efficiency of adhesion elimination is improved. Therefore, the size of the fans **305** and **306** can be reduced. In addition, the driving current can also be reduced. Therefore, the size of the apparatus can be reduced.

A predetermined distance G is set between the top lid **322** and the uppermost sheet so that the sheet feeding and the adhesion elimination can be smoothly performed. The distance G can be about 2 mm to 20 mm. If the distance G is smaller than 2 mm, the separation of sheets due to the levitation of sheets due to the blowing of air is imperfect. If the distance G is larger than 20 mm, when air is blown, the effect of enclosed space decreases.

In addition, in the case where the heater **310** is driven to blow hot air, even if the environment is highly humid or wet sheets are used, the sheet drying efficiency is much higher than that of a large feeding deck such as the above-described known example.

In addition, since a limited and enclosed sheet loading space can be formed, it is possible to reduce the size of the fans, heater, and so on, and to provide an apparatus that uses less power, is compact, and energy-efficient.

In addition, a sheet cassette **10** in which the sheet feeding assisting unit **300** of this embodiment is installed can be loaded in any cassette chamber, if necessary. For example, in the case of this embodiment, only one cassette chamber may be loaded with such sheet cassette. Alternatively, all four cassette chambers may be loaded with such sheet cassettes. Moreover, if the sheet feeding assisting unit **300** becomes unnecessary, it can easily be removed so as to return the sheet cassette to its normal state. Such a user-friendly apparatus can be provided.

As shown in FIG. **9**, the blowing ports **303***a* and **303***b* may be respectively provided with shutters **313** and **314** capable of moving up and down in the arrow direction. The shutters **313** and **314** serve as air swinging devices and have openings **313***a* and **314***b* through which air passes. FIG. **9** partly shows a section of the sheet feeding assisting unit **300** of this embodiment viewed from the right side. The shutters **313** and **314** can be moved up and down by a driving source and a driving mechanism (both not shown).

When air is blown against the stack of sheets S, the openings **313***a* and **314***b* vertically move with the vertical motion of the shutters **313** and **314**, thereby vertically swing the blowing air. Thus, air is sequentially blown into between the sheets, and the efficiency of adhesion elimination is further improved.

Second Exemplary Embodiment

In the first embodiment, air is taken in through the air intake **308** of the sheet feeding assisting unit **300** and is blown against the side surface of the stack of sheets in the sheet loading space **320** through the blowing ports **303***a* and **303***b*. However, the air blown out through the blowing ports **303***a* and **303***b* may be circulated in the sheet feeding assisting unit **300**. In the description of the sheet feeding apparatus of the second embodiment, only the differences from the first embodiment will be described in detail, and the description of components in common with the first embodiment will be omitted.

As shown in FIG. **10**, the inner wall **302** opposite the blowing ports **303***a* and **303***b* is provided with exhaust ports **302***a* and **302***b*, and the case **301** is provided with a circulation duct **340** in which air circulates. The air heated by the air heating mechanism **309** passes through the circulation duct **340** as shown by arrows and is repeatedly supplied to the sheet loading space **320**. Therefore, the air heating efficiency is improved. Therefore, the power consumption of the heater **310** can be reduced. During a continuous run, the heater **310** can be turned OFF. In this case, the size of the air intake **308** can be reduced, if necessary. In addition, if air is completely circulated in the case, the air intake **308** is not necessary.

In the first embodiment, the heater **310** is provided in the duct. However, the heater can be provided elsewhere as long as it can heat the air blowing against the sheets.

For example, as shown in FIG. **11**, an air heating mechanism **309'** including a heater **310** can be provided in the top lid **322**. This configuration makes it possible to heat the air and sheets in the sheet loading space **320** from above. This makes it possible to dry the sheets and ensures the sheet separation by air.

As described above, when the heater **310** is provided in the top lid **322**, it is not necessary to provide a heater in the duct **307**. Therefore, space can be saved in the sheet width direction of the sheet feeding assisting unit **300**. Therefore, wider sheets can be loaded.

In addition, in the first embodiment, the size of the sheet loading space **320** of the sheet feeding assisting unit **300** is fixed, and therefore the size of loadable sheets is also fixed. However, the size of loadable sheets can be made selectable by making the inner walls of the case **301** movable.

In this case, the fans **305** and **306** are moved together with the inner wall **303** so as to maintain the distance to the side surface of the stack of sheets, in terms of the efficiency of adhesive elimination by air.

Alternatively, instead of movable inner walls, side positioning plates that position both sides of the sheets and a rear positioning plate that positions the rear end of the sheets may be slidably provided in the sheet loading space **320**. In this case, the size of the sheet loading space **320** is set to the maximum size of loadable sheets.

In the first embodiment, since the top lid **322** is provided, the sheet loading space **320** is hermetically closed, and the efficiency of adhesion elimination by air blowing is improved. However, if the air blowing by the fans **305** and **306** is sufficiently strong, the sheet loading space **320** is not necessarily closed by the top lid **322**. In this case, compared to the case where the top lid **322** is provided, the size of the fans **305** and **306** is inevitably large but the number of parts is small because the top lid **322** is not provided.

In the first embodiment, the blowing ports **303***a* and **303***b* are provided in the inner wall **303** at the back of the apparatus (on the left side in the sheet feeding direction). However, of course, the blowing ports **303***a* and **303***b* can be provided in the inner wall **302** at the front of the apparatus (on the right side in the sheet feeding direction). Alternatively, both inner walls **302** and **303** can be provided with blowing ports.

In the first embodiment, the sheet tray **56'** of the sheet feeding assisting unit **300** is raised and lowered by the lifter plate **57** provided in the sheet cassette **10**. However, the cassette tray **56** may be pressed up by an urging device such as a spring provided in the sheet cassette **10**. In this case, when the sheet feeding assisting unit **300** is installed in the sheet cassette **10**, the sheet tray **56'** is pressed up by the urging device.

In addition, in the sheet feeding apparatus of the first embodiment, a retard roller separation technique is used for separating the sheets. However, the technique for separating sheets is not limited to this. Any other technique, for example, a separation pad technique can be used.

Third Exemplary Embodiment

Next, a third embodiment will be described with reference to FIGS. **12** to **15**. In the description of the sheet feeding apparatus of the third embodiment, only the differences from the first embodiment will be described in detail, and the description of components in common with the first embodiment will be omitted.

FIG. **12** is a horizontal sectional view showing the structure of a sheet feeding assisting unit **400** for feeding sheets difficult to separate, such as heavy paper and coated paper. FIG. **13** is a perspective view of the sheet feeding assisting unit **400**. FIGS. **14** and **15** are plan views showing a sheet cassette **10** in which the sheet feeding assisting unit **400** is installed.

The case **401** of the sheet feeding assisting unit **400** is rectangular-parallelepiped-shaped and is a size such that it can be installed in the sheet cassette. The sheet feeding assisting unit **400** has an air intake **408**, a heater **409**, a duct **407**, fans **405** and **406**, and blowing ports **403***a* and **403***b*. The air intake **408** is located in the rear surface in the sheet feeding direction. The heater **409** is provided in a path along which air flows in through the air intake **408**. The duct **407** is provided so as to lead the air discharged from the heater **409** to the fans **405** and **406**.

Due to this structure, the sheet feeding assisting unit **400** can efficiently take in air from the empty space in the sheet cassette **10** (from the rear in the sheet feeding direction). The air that flows in through the air intake **408** is heated by the heater **409**. Thus, by the fans **405** and **406** (air blowing devices), hot air can be blown out through the blowing ports **403***a* and **403***b* provided in a surface parallel to the sheet feeding direction.

The blowing ports **403***a* and **403***b* are provided in the upper part of the sheet feeding assisting unit **400**. Since the blowing ports **403***a* and **403***b* are substantially level with the top surface of the stack of sheets, hot air can be blown against the upper part of the side surface of the stack of sheets loaded in the cassette tray **56**. The blowing ports **403***a* and **403***b* are provided with a lattice or slits to prevent dust or foreign objects from entering the sheet feeding assisting unit **400**.

The procedure to install the sheet feeding assisting unit **400** in the sheet cassette **10** will be described with reference to FIG. **14**. First, to install the sheet feeding assisting unit **400**, the side positioning plates **51** and **52** provided in the sheet cassette **10** are moved so that the distance therebetween is the maximum. A plurality of positioning holes is provided in the sheet cassette **10** and serves as a mounting mechanism. A protrusion is provided on the bottom surface of the sheet feeding assisting unit **400**. The protrusion is fitted into a positioning hole corresponding to the width of the sheets.

In FIG. **14**, the sheet feeding assisting unit **400** is installed at the back of the sheet cassette **10**, and on the side of the side positioning plate **52**. However, the sheet feeding assisting unit **400** may be installed at the front of the sheet cassette **10**, and on the side of the side positioning plate **51**. Alternatively, the side positioning plate **52** may be detachable. In this case, the sheet feeding assisting unit **400** is installed in the place where the side positioning plate **52** has been detached.

The positioning holes are provided with a sensor that detects which positioning hole the protrusion of the sheet feeding assisting unit **400** is fitted into. With this sensor, the position of the sheet feeding assisting unit **400** can be detected, and therefore the size of the sheets loaded in the sheet cassette **10** can be detected.

The surface of the sheet feeding assisting unit **400** having the blowing ports **403***a* and **403***b* is flat and positions the sheets in the width direction together with the side positioning plate **51**. That is to say, as shown in FIG. **15**, the sheet feeding assisting unit **400** can be shifted so as to position the sheets in the width direction, with the side restricting plate **51** fixed.

Since the sheets are loaded against one side of the sheet cassette **10**, more variable sizes of sheets can be loaded compared to the case where the sheets are loaded in the center of the sheet cassette **10**. If the sheets are loaded in the center of

the sheet cassette **10** in which the sheet feeding assisting unit **400** is installed, a wasted space having the same width as the sheet feeding assisting unit **400** is formed on the side of the side positioning plate **51**, and therefore the size of loadable sheets is limited.

When the sensor detects that the sheet feeding assisting unit **400** is installed, the sensor informs the controller **120**. By receiving this information, the controller **120** detects that the sheets are loaded against one side, and accordingly changes the starting position of printing.

Finally, a connector **430** for sending and receiving electrical signals and control signals is coupled to a connecting cable (not shown) in the cassette chamber of the image forming apparatus **900**. The connecting cable is, for example, a flexible cable that maintains electrical connection even when the sheet cassette **10** is fully pulled out. Alternatively, electrical connection can be performed only when the sheet cassette **10** is loaded in the image forming apparatus body, using a drawer connector.

In the above description, the protrusion of the sheet feeding assisting unit **400** is fitted into one of the positioning holes provided in the sheet cassette **10**. However, the sheet feeding assisting unit **400** may be fixed to a slider that is provided in the sheet cassette **10** and slidable in the width direction. In this case, by sliding the slider, the sheet feeding assisting unit **400** also slides and positions the sheets in the width direction. In addition, the size of the sheets is detected by a sensor that detects the position of the slider. In the above description, the sheet feeding assisting unit **400** is disposed so as to blow air against the side surface of the stack of sheets. However, the present invention is not limited to this. Alternatively, the sheet feeding assisting unit **400** may be disposed so as to blow air against the front surface or the rear surface of the stack of sheets in the sheet feeding direction.

As described above in detail, the embodiments can be applied to relatively small apparatuses. By just installing a sheet feeding assisting unit in the sheet cassette, the apparatuses can separate and feed sheets difficult to separate, such as coated paper.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all modifications, equivalent structures and functions.

What is claimed is:

1. A sheet feeding apparatus for feeding sheets comprising:

a sheet cassette adapted to load sheets;

a sheet feeding member configured to feed the sheets loaded in the sheet cassette;

a sheet feeding assisting unit detachably attached to a sheet loading position where the sheets are loaded in the sheet cassette, wherein the sheet feeding assisting unit has a case where the sheets are loaded, and, when the sheet feeding assisting unit is attached to the sheet cassette, the sheet loaded in the case is fed by the sheet feeding member;

a sheet tray disposed in the case and configured to support the sheets to be fed by the sheet feeding member;

an air blowing mechanism disposed on the case of the sheet feeding assisting unit and operable to blow air against edges of the sheets supported by the sheet tray; and

a circulation duct disposed on the case and adapted to return the air blown against the sheets from the air blowing mechanism to the air blowing mechanism.

2. A sheet feeding apparatus for feeding sheets comprising:

a sheet cassette adapted to load sheets;

a sheet feeding member configured to feed the sheets loaded in the sheet cassette;

a sheet feeding assisting unit detachably attached to a sheet loading position where the sheets are loaded in the sheet cassette, wherein the sheet feeding assisting unit has a case where the sheets are loaded, and, when the sheet feeding assisting unit is attached to the sheet cassette, the sheet loaded in the case is fed by the sheet feeding member;

a sheet tray disposed in the case and configured to support the sheets to be fed by the sheet feeding member;

an air blowing mechanism disposed on the case of the sheet feeding assisting unit and operable to blow air against edges of the sheets supported by the sheet tray;

an opening that can pass air, the opening being defined in the inner wall of the case between the air blowing mechanism and a sheet loading space of the case; and

an air swinging device configured to swing the air blown against the sheets and being provided at the opening.

3. The sheet feeding apparatus according to claim **1**, wherein the air blowing mechanism includes an air heating mechanism configured to heat air to be blown out.

4. The sheet feeding apparatus according to claim **1**, wherein the air blowing mechanism includes a fan and a connector electrically connecting the fan to the sheet cassette when the sheet feeding assisting unit is attached to the sheet cassette.

5. An image forming apparatus that forms an image on a sheet, the apparatus comprising:

a sheet cassette adapted to load sheets;

a sheet feeding member configured to feed the sheets loaded in the sheet cassette;

a sheet feeding assisting unit detachably attached to a sheet loading position where the sheets are loaded in the sheet cassette, wherein the sheet feeding assisting unit has a case where the sheets are loaded, and, when the sheet feeding assisting unit is attached to the sheet cassette, the sheet loaded in the case is fed by the sheet feeding member;

a sheet tray disposed in the case configured to support the sheets to be fed by the sheet feeding member;

an air blowing mechanism disposed on the case of the sheet feeding assisting unit and operable to blow air against edges of the sheets supported by the sheet tray;

a circulation duct disposed on the case and adapted to return the air blown against the sheets from the air blowing mechanism to the air blowing mechanism; and

an image forming section configured to form an image on a sheet fed by the sheet feeding member.

6. An image forming apparatus that forms an image on a sheet, the apparatus comprising:

a sheet cassette adapted to load sheets;

a sheet feeding member configured to feed the sheets loaded in the sheet cassette;

a sheet feeding assisting unit detachably attached to a sheet loading position where the sheets are loaded in the sheet cassette, wherein the sheet feeding assisting unit has a case where the sheets are loaded, and, when the sheet feeding assisting unit is attached to the sheet cassette, the sheet loaded in the case is fed by the sheet feeding member;

a sheet tray disposed in the case configured to support the sheets to be fed by the sheet feeding member;

an air blowing mechanism disposed on the case of the sheet feeding assisting unit and operable to blow air against edges of the sheets supported by the sheet tray;

an opening that can pass air, the opening being defined in the inner wall of the case between the air blowing mechanism and a sheet loading space of the case;

an air swinging device configured to swing the air blown against the sheets and being provided at the opening; and

an image forming section configured to form an image on a sheet fed by the sheet feeding member.

7. The image forming apparatus according to claim **5**, wherein the air blowing mechanism includes an air heating mechanism configured to heat air to be blown out.

8. The image forming apparatus according to claim **5**, wherein the air blowing mechanism includes a fan and a connector electrically connecting the fan to the sheet cassette when the sheet feeding assisting unit is attached to the sheet cassette.

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